



## POWER FACTOR REGULATOR

computer 6m / computer 12m



Complete Manual  
Complete version  
(M98161301-03-05B)

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# 1. FEATURES



The **computer-6m / 12m** power factor regulators measure  $\cos \varphi$  in the system and regulate the connection and disconnection of the capacitors in order to correct it. Among current models there are the **computer 6m** and the **computer 12m**, with the difference being the number of relay outputs they are able to control.

Type:	Maximum number of outputs
<b>computer 6m</b>	6 relay outputs
<b>computer 12m</b>	12 relay outputs

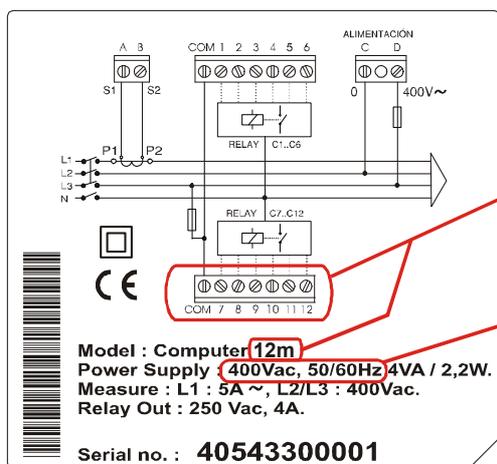
Some of the most important benefits are:

- FCP System minimising the number of capacitor connections and disconnections.
- 6 and 12 relay regulator according to type.
- Connected step display, digital display for  $\cos \varphi$  and differentiation of sign for reactive power L (inductive) and C (capacitive).
- THREE digit LCD display with seven segments.
- Setting of parameters without the need for disconnecting the regulator's power supply.
- Option to configure the regulator even when it is still in the process of regulating the capacitors.
- Option for using 50 or 60 Hz frequencies.
- All measurements displayed on one single display.
- Easy to mount with no need for tools.
- Programming from keypad on the front: (3 keys).
- Size according to DIN 43 700 of 144 x 144 mm
- Measurement and power supply in one single input.

## 1.1 Checks on receipt of the regulator

On receipt of the regulator, check that:

- The equipment has not been damaged during delivery.
- The model supplied is the same as the one ordered.
- Check the label on the back of the regulator.



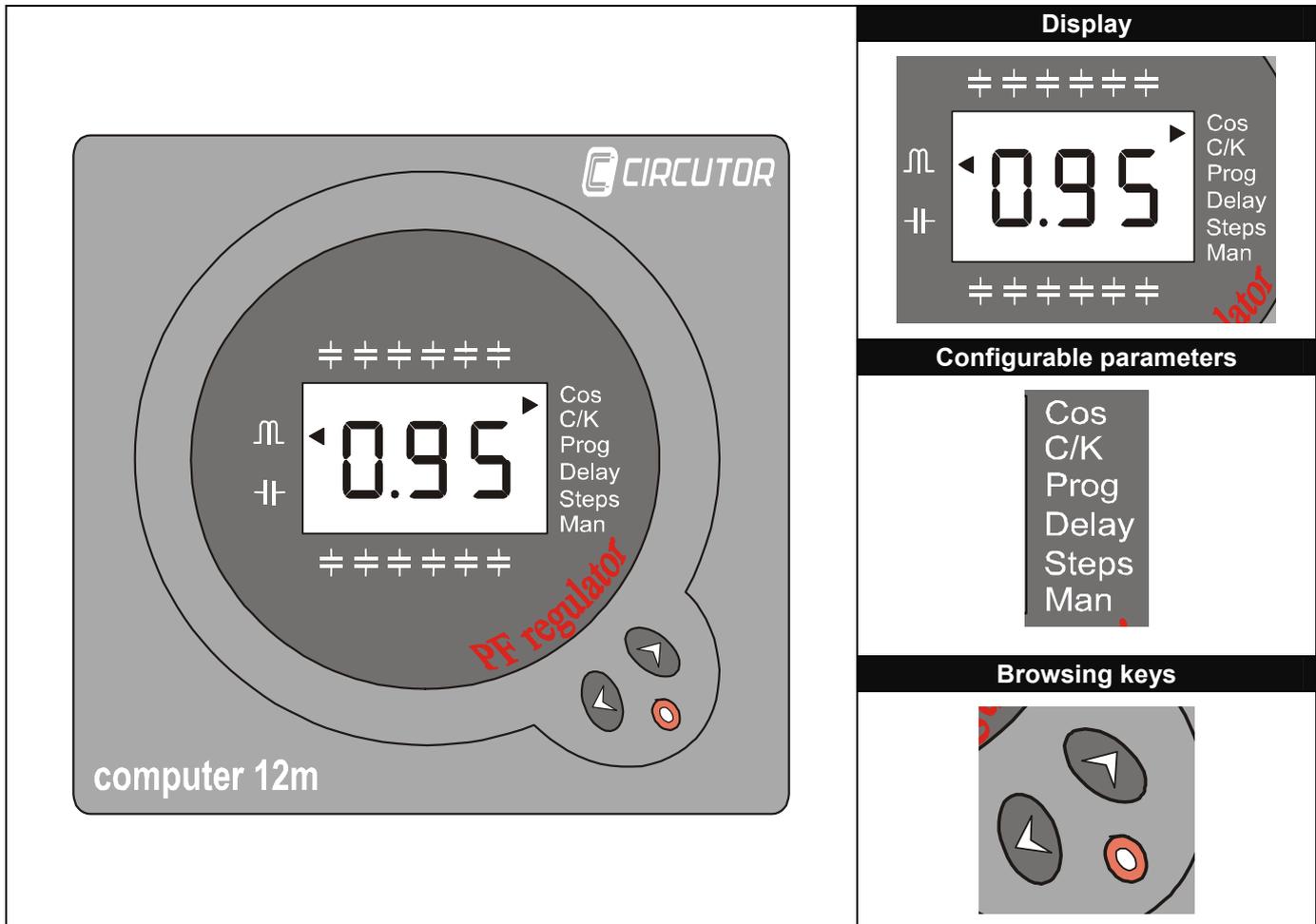
Number of relay outputs display according to type.  
**computer 6m** : 6 relays  
**computer 12m** : 12 relays

Power supply voltage and operating frequency display

- The voltage used by the equipment supplied matches the mains voltage where the regulator is to be installed.
- Follow the instructions in section 3 for the more installation and tuning.
- Contact the commercial service of CIRCUITOR, SA if any fault is observed

## 2. GENERAL DESCRIPTION

The regulator has the following displays on the front:



**NOTE:** The setting mode and parameter functions are described in further detail in the SETUP section.

### 1.1 Display

The regulator's display is 3 digit LCD with seven segments. It also has a series of icons which offer information on the condition of the regulator, such as showing  $\cos \varphi$  value,  $\varphi$  value and indicating the connected steps.

Indicates the value of  $\cos \varphi$  (inductive)

Indicates the value of  $\cos \varphi$  (capacitive)



Normally indicates  $\cos \varphi$

Indicates the connected and disconnected steps

### Alarm messages display

In the event of the equipment detecting an error, a code indicating the detected error is displayed. The alarms shown are:

Message	Description
000	Load current below the minimum or current transformer not connected (current minimum of measurement 0.1 A).
E.01	Current transformer incorrectly connected (S1-S2 inverted or incorrect phase connection).
E.02	<b>Over correction.</b> Disconnection is required and the relays are disconnected.
E.03	<b>Under correction.</b> Disconnection is required and all the relays are connected.

### 2.1. Browsing keys



The browsing keys have different functions according to the operating mode being used by the regulator. The operating modes are:

#### Normal Mode

This is the mode in which the regulator measures  $\cos \varphi$  and regulates the connection and disconnection of capacitors to correct it.

## Setting Mode

The mode allows the regulator's parameters to be set.

Functions of the keys in the different modes

### NORMAL MODE

	<b>Key to enter configuration mode:</b> Long press (over 1s): Enter setting mode
	<b>Manual capacitor connection</b> Long press (over 1s) the regulator sequentially connects the steps.
	<b>Manual capacitor disconnection</b> Long press (over 1s) the regulator sequentially disconnects the steps.

### SETTING MODE

	<b>Long press (over 1s):</b> Exit setting mode and save configured parameters. <b>Short press:</b> Enter/ Exit the parameter configuration (saving the set value).
	Browsing upwards through the parameter menu. Increasing the digits when setting the parameters.
	Downwards browsing through the parameter menu. Decreasing the digits when setting the parameters. Changing a digit to be set (parameter has more than 2 digits).

### 3. INSTALLATION AND START-UP

This manual contains information and warnings which must be followed by the user to maintain the equipment in a proper and safe working order.

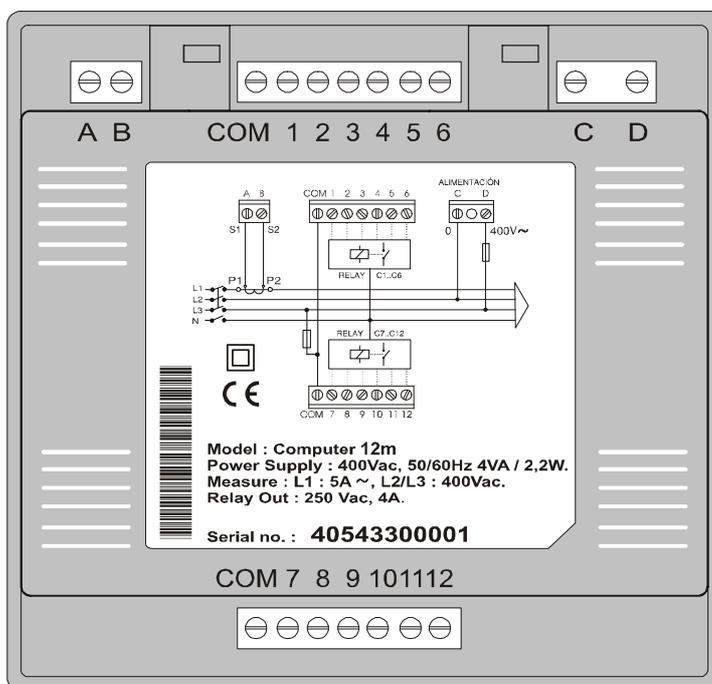
If the equipment is used in a way not specified by the manufacturer, the equipment's **protection may be compromised.**

If signs of wear are detected on the equipment or it does not perform correctly, the equipment must be disconnected from the supply. In this event please contact a qualified service representative.

For the safe use of the **computer 6m** or **computer 12m** regulators, it is vital that those persons installing or handling it follow the usual safety procedures as well as the specific warnings contained in this instruction manual.

#### 3.1. Installing the equipment

Before connecting the equipment, check the following:



**Power supply voltage:** (see on the back of **computer 6m** or **computer 12m**)

Terminals C and D between phases have to be connected to 110, 230, 400 or 480 V AC. (according to type).

- Frequency : 45 ... 65 Hz
- Power supply tolerance : + 15 % / --15 %
- Terminals connection : C - D
- Equipment consumption :
  - computer 6m:** 3 V.A / 1.8 W (without relays connected); 5.5 V.A / 4.5 W (6 relays connected)
  - computer 12m:** 4 V.A / 2.2 W (without relays connected); 8.5 V.A / 7.6 W (12 relays connected)

**Current measurement:**

- Transformer  $I_n / 5$  A AC.
- Terminals connection **A** and **B**.

**Operating conditions:**

- Operating temperature: - 10 °C / + 50 °C
- Humidity of operation: 25 to 80 % RH (without condensation)

**Safety:**

- Category III Installation, according to EN 61010.
- Protection against electric shock by double insulation (equipment class II)

### 3.2. Connection instructions



To safely use the **computer 6m** and **computer 12m** it is important that people installing it or handling it follow the usual safety precautions as well as the different warnings stated in this instruction manual. Care must be taken with the capacitors which may be charged and may discharge even after voltage is removed. Ensure that the capacitors have had time to discharge.

#### 3.2.1. CONNECTIONS

The equipment is installed on a panel (punched panel  $138^{+1} \times 138^{+1}$  mm, according to DIN 43 700).



All connections must remain inside the electrical board.

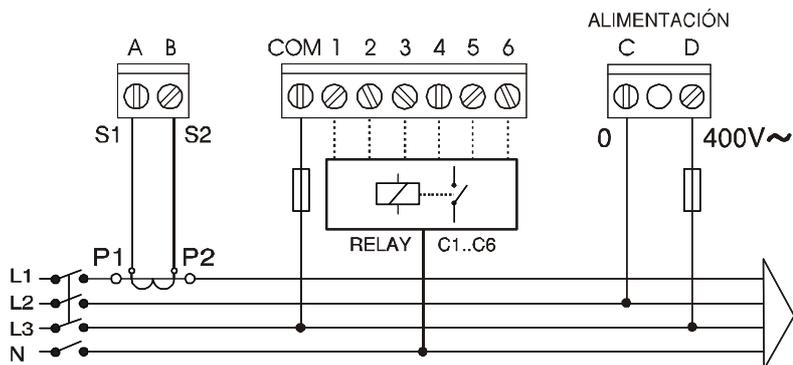
Bear in mind that when the equipment is connected, the terminals may be dangerous when touched and opening the covers or removing parts may access parts that are dangerous when touched. The equipment must not be used until it is fully installed.



The equipment must be connected to a power supply circuit protected with gI (IEC 269) or type M (IEC 127) fuses between 0.5 and 2 A. An earth leakage switch (I/O) or similar device must be fitted to connect (ON) or disconnect (OFF) the equipment from the supply power system. This must be installed near to the equipment with easy access. The voltage power supply circuit and the differential relay connections are connected by a  $1.5 \text{ mm}^2$  diameter cable. The current transformer secondary line must be  $2.5 \text{ mm}^2$  in diameter as a minimum.

3.2.2. Terminal layout:

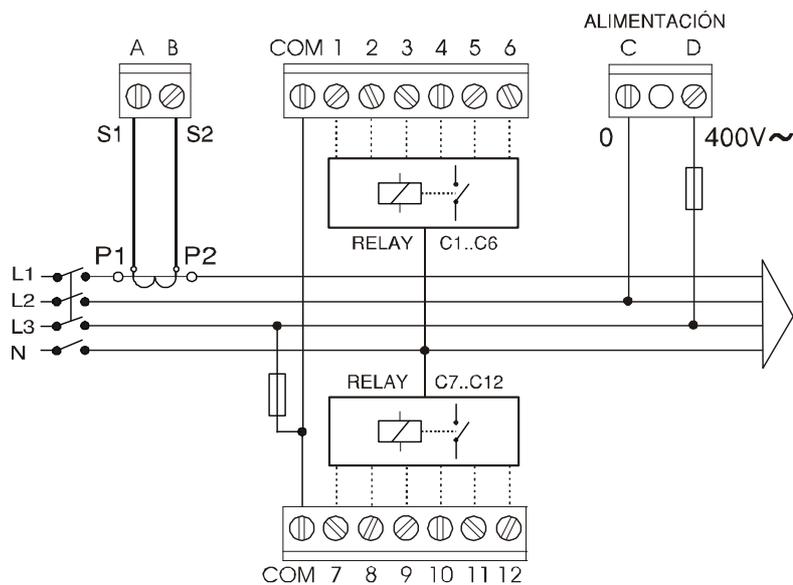
**computer 6m**



No.	Terminal description
A	Current input S1
B	Current input S2
COM	Common Relays
1	Relay output 1
2	Relay output 2
3	Relay output 3
4	Relay output 4
5	Relay output 5
6	Relay output 6
C	Voltage input 0 V
D	Voltage input *
	110 V AC. or 230 V AC.
	400 V AC. or 480 V AC.

\* According to type

**computer 12m**



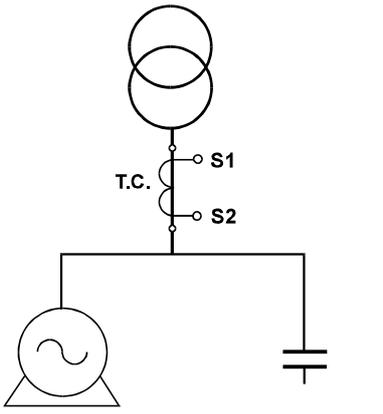
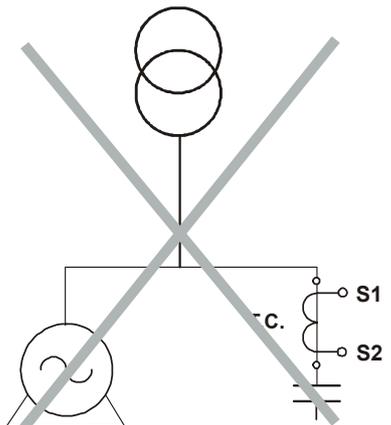
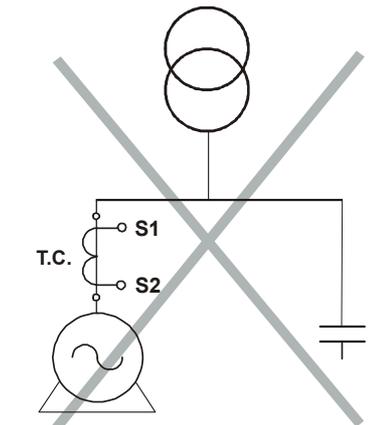
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A	Current input S1
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COM	Common Relays
1	Relay output 1
2	Relay output 2
3	Relay output 3
4	Relay output 4
5	Relay output 5
6	Relay output 6
7	Relay output 7
8	Relay output 8
9	Relay output 9
10	Relay output 10
11	Relay output 11
12	Relay output 12
C	Voltage input 0 V
D	Voltage input *
	110 V AC. or 230 V AC.
	400 V AC. or 480 V AC.

\* According to type

**NB:** The COM connection is not an internal connection. This means that the 12 relay output model must short circuit the two COM outputs on the regulator.

Use the connection diagram on the rear of the regulator to connect it. To do so, bear in mind the following points:

- It is necessary to install a current transformer in order to start (normally **In / 5 A**) in accordance with **the total current of the installed receivers**. The current transformer secondary line must have the appropriate diameter in terms of its distance from the regulator. (minimum 2.5 mm<sup>2</sup>)
- The power supply voltage for the regulator is **between phases** (except when it is a special single phase regulator). **Voltage must be taken from the two phases where there is no current transformer**. The phase where the current transformer is installed **does not coincide with** any of the phases from which voltage is being taken to supply the regulator.
- The current transformer is installed at a point where all of the load currents to be corrected plus the capacitor current are passing.

CORRECT	INCORRECT	
 <p>The current transformer has to be in front of the bank and the receivers (motors, etc).</p>	 <p>- No capacitor will be connected because the current transformer does not give any signal. - Check that the CT is not short circuiting or installed outside the loads.</p>	 <p>- All capacitors in the bank are connected, but do not disconnect when the load decreases. Risk of overcorrecting the system without a load.</p>

Connect the current transformer secondary (S1-S2) onto the terminals marked S1-S2 (1 and 2). If a  $\cos \varphi$  value appears on the display which does not match, it means that the phase progress is wrong: invert the connection of the voltage phases on the regulator (or invert S1-S2 on the current transformer secondary).

## 4. TECHNICAL FEATURES

<b>Power supply voltage (terminals C-D)</b>	110 VAC. or 230 VAC. or 400 VAC. or 480 VAC. * +15% -10% ; 45-65 Hz
<b>Voltage measurement (terminals C-D)</b>	Connector to phases L2 and L3
<b>Voltage measurement range</b>	110 VAC. or 230 VAC. or 400 VAC. or 480 VAC. * + 15 % / - 10 %
<b>Voltage measurement accuracy</b>	1%
<b>Current measurement circuit</b>	Current transformer (CT) , / 5
<b>CT connection</b>	Phase 1, IL1
<b>Current measurement range ( IL1 )</b>	0.1 to 5 A (max. +20%)
<b>Current measurement accuracy</b>	1%
<b>Cos <math>\phi</math> measurement accuracy</b>	2% $\pm$ 1 digit
<b>Frequency margin, V(C-D)</b>	45-65 Hz
<b>Consumption: computer 6m                           computer 12m</b>	3 V.A/1.8 W (without relays); 5.5 V.A/4.5 W (6 relays connected) 4 V.A/2.2 W (without relays)/8.5 V.A/7.6 W (12 relays connected)
<b>Display</b>	1 line x 3 digits x 7 segments + 20 icons
<b>Relay output</b>	Max. 250 V, 4 A AC1
<b>Standards</b>	EN 61010, EN 61000-3-2, EN 61000-3-3, EN 50081-2, EN 50082-1, EN 50082-2, EN 61000-4-2, EN 61000-4-4, EN 61000-4-8, EN 61000-4-5, EN 61000-4-11 , UL 94
<b>Safety/Insulation</b>	According to EN 61010-1, Category III, Ambient 2
<b>Protection grade</b>	IP 30 (non assembled equipment) according to EN 60529 IP 21 (assembled equipment, front)
<b>Control system</b>	FCP (Minimum operation program)
<b>Dimensions</b>	144 x 144 x 62 mm
<b>Weight</b>	0.538 kg

\* According to type

## 5. SETTING THE REGULATOR

The following parameters may be set using the programming mode.

The ► icon shows the selected parameter.

	Parameter	Description
	► Cos	Cosine of $\cos \varphi$ ( 0.85 Ind – 0.95 Cap)
	► C/K	Cosine of C / K ( 0.02-1.00 )
	► Prog	Operating program: 1.1.1.1.1 / 1.2.2.2.2 / 1.2.4.4.4 / 1.1.2.2.2 / 1.2.4.8.8
	► Delay	Capacitor connection time (4 to 999 secs.)
	► Steps	<b>computer 6m:</b> up to 6 relays <b>computer 12m:</b> up to 12 relays

$\cos \varphi$

values between 0.85 inductive and 0.95 capacitive may be set

C / K

The current for the first capacitor on the bank is set by dividing the current transformer ratio (see example 6.4.2)

Prog: (Selection of connection program)

The programs for connecting the capacitors are:

Program 1: 1.1.1.1.1  
 Program 2: 1.2.2.2.2  
 Program 3: 1.2.4.4.4  
 Program 4: 1.2.4.8.8  
 Program 5: 1.1.2.2.2

Delay:

Regulates the time  $T_c$  between connection and disconnection of capacitors and the time of reclosure after a capacitor has disconnected  $T_r$ . ( $T_r$  is always  $5 \cdot T_c$ )

Connection time of the capacitors: from 4 secs. to 999 secs.  
 Discharge time for the capacitors (safety time): from 20 s to 999 s.

Steps:

Allows the number of relay outputs a regulator will have to be set.  
 According to type up to 6 or up to 12 relays may be set.

## 5.1. Assistance signs

Keys	Function
	Flashing symbol on the display indicates the parameter being edited. 1 digit flashing means that the value of that digit may be changed.
	Indicates that the capacitor connection is being manually forced. Capacitor connection can only be forced when the regulator is in normal operating mode and there is no alarm message.

## 5.2. Parameter setting sequence

### Access to the setting menu.

To access the set up menu of the equipment, follow procedure below:

With a long press (over 1s): of the setting key , the equipment goes into setting mode (programming), whenever all capacitors are disconnected. If not, keep the  key pressed down while the disconnection sequence starts. Once the sequence has ended the regulator returns to the setting menu.



### IMPORTANT:

Whilst it is in setting menu, if no key is pressed for 3 minutes the equipment exits setting mode and goes into normal mode **without saving the parameters set. To exit the setting menu and to save the set parameters, press the setting key for more than 1s.**

#### 5.2.1. Cosine of $\cos \varphi$



The range of  $\cos \varphi$  is from 0.85 L1 (Inductive) and 0.95 C (Capacitive), always positive values because it only takes into account the direction of current consumption. Normally this value is set on 1.0 (Inductive reactive power = Capacitive reactive power of the bank).

#### 5.2.2. Setting reactive current C / K



In order for the regulator to work properly, the ratio between the first capacitor and the installed current transformer has to be indicated. This is done by using the **C / K** parameter setting.

This parameter is set using the following formula to calculate it:

$$\text{Transformer ratio } \frac{I_t}{5} = K$$

Setting the control of reactive current  $C / K = \frac{I_c}{K}$  ;  $I_c = \frac{Q}{\sqrt{3} \cdot V}$

being:  $I_t$  = rated current of the transformer

$I_c$  = first capacitor current (relay 1)

**Q**, reactive power of the 1 capacitor in Kvar.

**U**, power supply voltage phase-phase

Example:

Transformer ratio:  $\frac{500}{5} = K = 100$

First capacitor: 60 kvar to 400 V  $\Rightarrow I_c = \frac{60,000}{1.73 \times 400} = 86.7 \text{ A}$

Setting the reactive current control  $C / K = \frac{I_c}{K} = \frac{86.7}{100} = 0.867$

The following table shows characteristic C / K settings.

Transf. ratio (A)	Potencia en kvar del primer escalón a 400V / Power in kvar of first step at 400 V															
	Transformer	2.5	5.00	7.5	10.0	12.5	15.0	20.0	25.0	30.0	37.5	40.0	50.0	60.0	75.0	80.0
150/5	0.12	0.24	0.36	0.48	0.60	0.72	0.96									
200/5	0.09	0.18	0.27	0.36	0.45	0.54	0.72	0.90								
250/5	0.07	0.14	0.22	0.29	0.36	0.43	0.58	0.72	0.87							
300/5	0.06	0.12	0.18	0.24	0.30	0.36	0.48	0.60	0.72	0.90	0.96					
400/5	0.05	0.09	0.14	0.18	0.23	0.24	0.36	0.48	0.58	0.67	0.72	0.87				
500/5		0.07	0.11	0.14	0.18	0.22	0.29	0.36	0.45	0.54	0.54	0.72	0.87			
600/5		0.06	0.09	0.12	0.15	0.18	0.24	0.30	0.36	0.45	0.48	0.60	0.72	0.90	0.96	
800/5			0.07	0.09	0.11	0.14	0.18	0.23	0.27	0.33	0.36	0.45	0.54	0.68	0.72	
1000/5			0.05	0.07	0.09	0.11	0.14	0.18	0.22	0.27	0.29	0.36	0.43	0.54	0.57	
1500/5				0.05	0.06	0.07	0.10	0.12	0.14	0.18	0.19	0.24	0.29	0.36	0.38	
2000/5						0.05	0.07	0.09	0.11	0.13	0.14	0.18	0.22	0.27	0.28	
2500/5							0.06	0.07	0.09	0.10	0.12	0.14	0.17	0.22	0.23	
3000/5							0.05	0.06	0.07	0.09	0.10	0.12	0.14	0.18	0.19	
4000/5									0.05	0.06	0.07	0.09	0.11	0.14	0.14	



### IMPORTANT:

- If the C / K setting remains low, there will be connections and disconnections with little load variations.
- If the C / K setting remains high, a higher consumption will be necessary so that the steps enter. The regulator interprets that it has higher power steps.

## 5.2.3. Selection of type of operation



The selected operating program for the regulator will depend on the power (kvar) of the different capacitor steps forming the bank.

Operation type	Description	Example: composition of bank (kvar)
1.1.1.1.1	All capacitors with <b>SAME</b> power	20 + 20 + 20 + 20
1.2.2.2.2	The first capacitor is half the power of the rest	20 + 40 + 40 + 40
1.2.4.4.4	If the first group has one power, the 2 <sup>nd</sup> capacitor has double power and the rest 4 times the power	20 + 40 + 80 + 80
1.1.2.2.2	The 1 <sup>st</sup> and 2 <sup>nd</sup> is half the power than the rest	20 + 20 + 40 + 40
1.2.4.8.8	If the first group has one power, the 2 <sup>nd</sup> is double power, the 3 <sup>rd</sup> is 4 times the power and the rest 8 times the power	10 + 20 + 40 + 80

## 5.2.4. Delay: Setting connection and disconnection times



The delay time (**Tr**) for connection /disconnection between steps may be set between 4 and 999 seconds. Safety time between disconnecting a capacitor and its reconnection (this safety time is always 5 times the connection time TC) **Ts = 5 Tr**

When voltage is passed to the regulator, wait a minimum of Ts when connecting the first step.

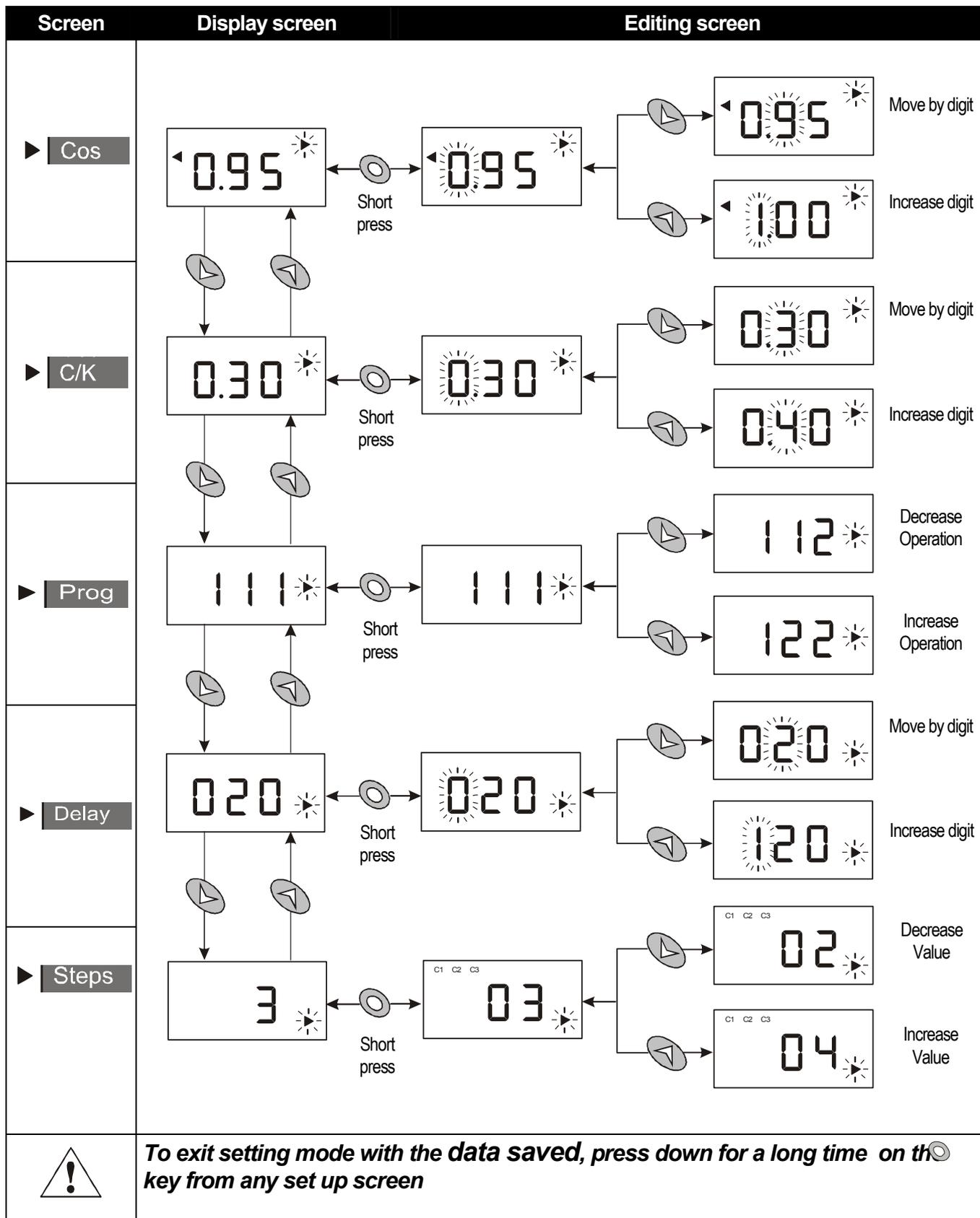
## 5.2.5. Steps: Setting the number of relay outputs



Parameter where the number of outputs controlling the regulator is set. This may be 6 or 12 relays according to type.

Type:	Maximum number of outputs
computer 6m	6 relay outputs
computer 12m	12 relay outputs

5.2.6. Setting sequence



## 6. SAFETY ADVICE



The equipment installation rules described in the previous INSTALLATION, START UP, TYPES OF INSTALLATION AND TECHNICAL FEATURES sections must be taken into account. Once connected the terminals may be dangerous when touched and opening the covers or removing parts may access parts that are dangerous when touched. This equipment is supplied in good working order.

## 7. MAINTENANCE

The **computer 6m** or **computer 12m** regulators do not require special maintenance. Any adjustment, maintenance or repair to the open equipment is to be avoided as far as possible. If it cannot be avoided it must be undertaken by someone qualified and well informed of the necessary action.

Before any modification to the connections, replacement, maintenance or repair, the equipment must be disconnected from the supply. When any operational or protection fault is suspected the equipment must be withdrawn from service and any accidental connection must be avoided. The equipment is designed to be changed quickly in the event of any breakdown.

## 8. TECHNICAL SERVICE

In the event of any equipment failure or any operational queries please contact the technical service of CIRCUTOR, SA.

CIRCUTOR, SA. - After sales service.  
Vial Sant Jordi, s/n  
08232 – Viladecavalls (Barcelona)  
Tel. - (+34) 93 745 29 00  
Fax. - (+34) 93 745 29 14  
e-mail - central@circutor.es